Abstract

A combination of target shaping impedance loading and *Radar Absorbing Materials* (RAMs) have been used in the past for studying the reduction of *Radar Cross Section* (RCS) These techniques have their own advantages and limitations Recently the chiral materials have received wide attention for RCS reduction and are perceived to offer advantages over RAM This thesis is directed towards quantitatively substantiating the advantages of chiral composites for RCS reduction

The thesis is mainly divided into two parts The first part addresses the development of Computational Electromagnetic techniques for systematically analysing the scattering characteristics—represented by radar scattering absorption and extinction cross sections of chirally coated simple and complex shaped scatterers The second part of the thesis uses these techniques to obtain qualitative comparison of the chiral composites over conventional radar absorbing materials when used as a coating material

The Mie s formulation has been successfully used in the past for studying the scattering characteristics of canonical shapes such as cylinders and spheres In this thesis the formulation was adapted to include chiral layers as well Computer codes have been developed to compute the scattering characteristics of chirally coated cylinders and spheres An extensive comparison between a chiral and RAM coating is made for RCS The results show that there is a 13–15 dB reduction in RCS when chiral coatings are used instead of RAMs for both cylindrical and spherical shaped bodies

The analysis of scattering from arbitrary multi layered scatterers has been carried out by developing a generalised technique such as the *Extended Boundary Condition Method* (EBCM) This technique is versatile enough to handle a wide range of combination of layers which could be a conductor dielectric or chiral This also has the advantage of being easily extendable to a variety of arbitrary shaped bodies For illustration and for comparison of chiral materials with RAMs a large number of results have been computed These results show that there is a 10–15 dB reduction in RCS over larger aspect angles as compared to RAM coatings The coating thickness required for RCS reduction is smaller as compared to that of RAMs

The reduction in RCS of chirally coated cylinders spheres and spheroids was confirmed to be due to increased absorption and reduced scattering

The chiral materials have been made elsewhere using metallic helices as inclusions in an epoxy host medium The constitutive parameters viz the dielectric constant ϵ_r the relative permeability μ_r and the chirality parameter β have been measured experimentally These have been used to compute the scattering characteristics of chirally coated cylinders spheres and spheroids A reduction of 10 dB in RCS has been observed with chiral coatings over that of RAMs for a wider aspect angle

Thus the numerical techniques developed as a part of this thesis have demonstrated that for a wide spectrum of target shapes — spheres cylinders spheroids etc the chiral composites yield around 10 dB better RCS reduction possible with conventional RAMs